Research on Competitiveness of Chinese Construction Enterprises by Factor Analysis

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Abstract: Construction industry has already become the pillar sector of the national economy, its competitiveness has the decisive significance regarding to the survival and development of construction enterprises. On the basis of the related research, this paper proposed 15 key indicators of the competitiveness, and by making use of the factor analysis method, three principal components had been found, they were scale, performance, and technology of the construction enterprises. And then this paper discussed the development status of the competitiveness to the construction enterprises in China, the statistical dates of 31 provinces used in 2009. Finally with comparing and analyzing the competitiveness in terms of the whole construction industry, some mestrures and suggestions had been proposed for the future development of the construction enterprises in China.
Key words: Construction enterprise; Competitiveness; Factor analysis; Comprehensive assessment

1 Introduction

As the pillar sector of the national economy in Chian, construction has played a vital role to the development of society and economic. In recent years, with the increase of the speed of the urbanization, the construction of the infrastructrue has become larger than any time before. According to "China Statistical annual 2010", there were 70817 construction enterprises in 2009, and the number of employed people had arrived at 3672.56million increased by 10.8% over the previous year. The total output value of construction industry reached at 7.68trillion yuan increased by 23.8% over the previous year, meanwhile the value added of construction was 1.56trillion yuan increased by 25.1% over the previous year. With the fierce competitions which come from the rapid growth of construction industry, how to improve the competitiveness of the construction enterprises has become a critical factor for the construction enterprises management.

The construction enterprise competitiveness is the comprehensive capacity which the construction enterprises can sufficiently and constantly provide productions or service to the market compareing to other enterprises, and meanwhile, benefits and self development can be obtained over the proceeding (Jinbei, 2001). According to the present literatures, the researches of domestic and foreign scholar about construction enterprise competitiveness are followed.

To investigate the driving forces and trends that will affect engineering and construction competition in the next decade, a research project, called the "Anatomy of Construction Competition in the Year 2000" (Yates ET al.1992), and was sponsored by the Construction Industry Institute's Construction 2000 Task Force. The project examined the factors that affect competitiveness, including corporate capabilities, financing capabilities, management and organization capabilities, work force characteristics and technological issues. Serdar Kaleand and David Arditi discussed the effects of competitive on two dimensions-scope and mode of competition. The variables of size, cost, quality, plan and innovation have been considered as the impact factors of the construction enterprise competitiveness accorading to this literature.

After the concept of construction enterprise competitiveness had introduced to China, experts had conducted some researches on this subject in Chian. Lu Wenxue evaluated the external competitiveness on five aspects including construction experience, financial capacity, human capacity, equipment capacity and contractual capacity on the background of construction market. Dong Rui set up an index system of management competence in construction enterprises based on analyzing the composed of management competitiveness which including business capacity, market control capacity, technological innovation ability, project management ability, resource management ability, organization managed capacity, enterprise culture and environment coordinated ability, and applied fuzzy comprehensive evaluating model to evaluate construction enterprise competitiveness. Ruan Lianfa set up an index system including scale competitive ability, market competitiveness, economic efficiency competitive ability, project management competitiveness and resources competitiveness based on the summarizing of the existed four index systems.

To sum up, most of the researches on construction enterprises competitiveness home and abroad focused on the evaluation index system with the purpose of evaluating the level of competitiveness and after that the measures or strategys would be proposed to improve the competitiveness. Based on these researches this paper proposed 15 factors to descrip the situation of the constructiion enterprise competitive by using the statistical dates of 31 provincese in 2009. With the result, the enterprises would understand the external development environment correctly, and it is helpful for the future competitive strategy making.

2 The Seletion of the Related Indicators

There are many factors influent construction competitiveness, and this paper chose 15 factors as the indexs to evaluate the lever of the construction enterprises competitiveness. (Shown as Table1)

Table 1 The Indicator System

Variable	Indicator		Variable	Indicator
X1	Gross Output Value of Construction (100 million yuan)		X9	Completion rate (%)
X2	Value Added of Construction (100 million yuan)		X10	Ratio of Profit to Gross Output Value (%)
X3	Number of Construction Enterprises (unit)		X11	Per Capita Profit (10 000yuan/person)
X4	Number of Employed Persons (10 000 persons)		X12	Value of Machines per Laborer (yuan/person)
X5	Assets of Construction Enterprises (10 000 yuan)		X13	Power of Machines per Laborer (kw/person)
X6	Total Profits (100 million yuan)		X14	Ration of Own completed Output Value compared with Out-sourced (%)
X7	Ratio of Pre-tax Profits to Output Value (%)		X15	Per Captia Output Value (10 000yuan/person)
X8	Ratio of Pre-tax Profits to Assets (%)			

Gross output value and value added of construction are referring to the fincal achievement of the construction enterprise with the form of money during the reporting period. Number of construction enterprise and employed person with the assets of construction enterprises will reflect the scale of the construction industry together to some extent. Profit is a key indicator of operation effectiveness. Ratio of pre-tax profits to output valve and assets represent the level of contribution and profit to society. Completion rates relate to the technical and good faith of the enterprises. Value and power of machines per labore influence the labor productivity directly. Ration of own completed output value compared with out-sourced is the representative of contract ability. This article used these 15 representational indicators to describe the level of construction enterprise competitiveness.

3 Data and Methodology

3.1 The method of factor analysis

This paper chose the method of factor analysis to appraise the level of construction enterprises competitiveness in Chian. Factor analysis is a statistical method to deal with multivariate data, which condenses a large number of original variables into a handful of factor variables with the minimum loss of information and dispels the correlation in multi-indices and lower the number of indices. (Hao, 2007)

3.2 Factor analysis model

This paper chose 15 indicators and used the dates of the 31 provinces in 2009 to evalute the level of construction enterprise competitiveness. The dates come from “China Statistical annual 2010”. As a lot of date is related, it not only increases the complexity of the analysis, but also affects the accuracy of the analysis. This paper used principal component analysis to reduce the number of index, and to integrate the information in all variablies with less comprehensive index. Pricipal component analysis indicated the level of related factor about the construction enterprises competitiveness development, and revealed the disparities almong the 31 provinces. According to the result, the construction enterprises would find the measures to improve the competitiveness.

3.3 Principal component nalysis

This paper used SPSS 17.0 to analyze 15 variables with the method of factor analysis. According to the correlation matrix, there were not only positive or negative correlations but also strong or weak correlations between these 15 indexs. The srtong correlations between indexs explained that information

of indicators exist a large degree of overlap. The test of KMO and Bartlett is carried out. The value of Sig. is 0.000, less than the significance level of 0.05 in Bartlett's Test of Sphericity, and meanwhile the value of KMO is 0.703. So factor analysis can be used to analyze the situation of the construction enterprises competitiveness.

As the table 2 showing, this paper selected three of principal component F1, F2, F3, which there total percentages accumulative can reach at 83.92%. So the three common factors may reflect the original information of 83.92%.

Table 2 Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.591	37.271	37.271	5.591	37.271	37.271	5.584	37.228	37.228
2	3.858	25.720	62.991	3.858	25.720	62.991	3.578	23.856	61.084
3	3.139	20.925	83.917	3.139	20.925	83.917	3.425	22.833	83.917
4	.994	6.624	90.541						
5	.500	3.335	93.876						
6	.338	2.253	96.129						
7	.291	1.938	98.068						
8	.170	1.131	99.199						
9	.041	.276	99.475						
10	.031	.205	99.680						
11	.017	.116	99.796						
12	.016	.105	99.901						
13	.006	.040	99.941						
14	.005	.034	99.975						
15	.004	.025	100.000						

The representativeness of the various in the component matrix were not obvious, so it is hard for these principal components to explan the 15 variables. This paper used the method of varimax to rotate the variables. The ratated component matrix is shown in table3.

Table 3 Rotated Component Matrixa

	Component						
	1	2	3		1	2	3
X1	.977	-.058	.060	X9	-.179	.532	-.409
X2	.972	-.021	-.102	X10	-.010	.968	.070
X3	.913	-.037	-.188	X11	-.012	.697	.690
X4	.949	-.056	-.230	X12	-.241	-.246	.686
X5	.862	-.041	.466	X13	-.348	-.365	.379
X6	.979	.055	.116	X14	.167	-.040	.874
X7	-.077	.969	.025	X15	-.038	-.001	.937
X8	.055	.852	-.431				

F1 representing the first principal component, can be seen as a composite index including gross output value of construction, value added of construction, number of construction enterprises, number of employed persons, assets of construction enterprises and total profits, and reflected the scale of the construction enterprises. F2 representing the second principal componente index including ratio of pre-tax profits to output value, ratio of pre-tax profits to assets, completion rate and ratio of profit to gross output value, and reflected the performance of the enterprises. F3 representing the per-capita profit, value of machines per laborer, power of machines per laborer, ration of own completed output value

compared with out-sourced and per captia output value, and reflected the ability of technology. At the end this paper estabilished the evaluation index system of construction enterprises competitiveness by using F1, F2 and F3 as the first order index and these 15 indicators as the secondary index.

3.4 Result of the analysis

Based on the evaluation index system, the component score was calculated with SPSS17.0. The component sore coefficient matrix is shown in table4.

Table 4 Component Score Coefficient Matrix

	Component						
	1	2	3		1	2	3
X1	.175	-.009	.020	X9	-.031	.138	-.106
X2	.174	-.003	-.027	X10	.004	.275	.049
X3	.163	-.011	-.053	X11	.005	.217	.224
X4	.169	-.017	-.066	X12	-.042	-.051	.194
X5	.156	.007	.140	X13	-.063	-.094	.100
X6	.176	.024	.040	X14	.033	.015	.257
X7	-.008	.274	.035	X15	-.003	.026	.276
X8	.013	.228	-.102				

The score was used as the weight of the factor indicator. Therefore it could calculate the important factors according to table 4. By sorting the overall score, it could find that the competitiveness of 13 regions, which their overall scores were higher than 0, were better than the other 18 regions which their overall scores were below 0. The higher score the region hads, the stronger the competitiveness was. In Beijing, Guangdong and Shanghai, the level of F1, F2 and F3 were almost same, it illuminates that the development of competitiveness in these regions were balanced and reasonable. In Jiangsu, Zhejing, Shandong, Henan of Chian the level of F1 was much higher than the other two factors F2 and F3, so their development of competitiveness was depended upon scale of the enterprise. On the contrary, in Tibet, Inter Mongolia and Tianjin of Chian, their levels of F2 and F3 is much higher than F1, it indicated that their development of competitiveness are depended on the ability of performance and technology. In Sichuan of China, its level of F1 was higher than most of other provinces, but the score of F2 and F3 are lower than the average of China. The result was shown in table 5.

Table 5 Comprehensive Assessment

Region	F1	Order	F2	Order	F3	Order	Overall	Order
Beijin	0.637	5	0.366	6	3.770	1	1.185	1
Jiangsu	3.235	1	0.097	9	-0.314	14	1.156	2
Zhejiang	2.472	2	-0.212	19	-0.576	23	0.738	3
Tibet	-0.972	29	4.221	1	0.252	7	0.703	4
Guangdong	0.954	4	0.185	7	0.794	4	0.581	5
Shanghai	0.509	8	-0.068	15	1.728	3	0.568	6
Shandong	1.446	3	0.120	8	-0.414	17	0.472	7
Inter Mongolia	-0.487	21	1.826	2	-0.340	16	0.177	8
Tianjin	-0.624	23	-0.726	26	2.241	2	0.106	9
Hubei	0.267	10	-0.113	17	0.130	10	0.102	10
Liaoning	0.313	9	-0.001	13	-0.111	12	0.091	11
Chongqing	0.058	12	0.597	5	-0.416	18	0.069	12
Henan	0.576	6	-0.077	16	-0.664	26	0.045	13
Sichuan	0.532	7	-0.409	23	-0.697	28	-0.059	14
Heilongjiang	-0.398	17	0.899	3	-0.572	22	-0.065	15
Shaanxi	-0.155	16	-0.378	21	0.157	9	-0.112	16
Hunan	0.026	14	0.091	17	-0.665	27	-0.121	17

Region	F1	Order	F2	Order	F3	Order	Overall	Order
Anhui	0.032	13	-0.045	14	-0.643	25	-0.146	18
Hebei	-0.052	15	-0.393	22	-0.314	15	-0.185	19
Fujian	0.072	11	-0.206	18	-0.726	29	-0.188	20
Jilin	-0.666	24	0.666	4	-0.544	19	-0.213	21
Jiangxi	-0.413	18	0.067	11	-0.793	31	-0.319	22
Yunnan	-0.436	19	-0.347	20	-0.559	20	-0.373	23
Xinjiang	-0.936	27	-0.780	28	0.572	6	-0.404	24
Shanxi	-0.459	20	-1.169	30	0.039	11	-0.441	25
Ningxia	-1.163	31	-0.744	27	0.661	5	-0.460	26
Hainan	-0.904	26	0.045	12	-0.775	30	-0.503	27
Guangxi	-0.620	22	-0.718	24	-0.561	21	-0.530	28
Qinghai	-1.134	30	-0.721	25	0.203	8	-0.548	29
Gansu	-0.967	28	-0.825	29	-0.242	13	-0.612	30
Guuizhou	-0.737	25	-1.249	31	-0.621	24	-0.714	31

4 Conclusion

This paper established an evaluation index system on the basis of the related research and the result of statistical data analysising. This evalution index system constituted with 3 first order indexes and 15 secondary indexes. By using this evalution index system and the corresponding statistical date of 31 provinces in 2009, this paper described the status of the development of construction enterprises competitiveness in China. Come to the result it can be foud that scale of the enterprise is not the most importment indicator. It is not reasonable for the enterprises to improving their competitiveness only by the way of expanding production or increasing the scale. They must focus on the measures of improving the ability of performance and technology. Only in this way, can the construction enterprises succeed in the competitive market.

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